

# *Hong Kong Entomological Bulletin*





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# First record of the Harpalinae (Coleoptera: Carabidae) tribe Zuphiini from Hong Kong and the subtribe Patriziina Basilewsky, 1953 from China.

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**Abstract.** The first record of *Agastus lineatus* Schmidt-Goebel 1846 and the subtribe Patriziina Basilewsky, 1953 is given for China. A list and key to the species of Zuphiini recorded in China is also presented

**Key words.** Zuphiini, Carabidae, Hong Kong, China.

## INTRODUCTION

The Zuphiini is a very small and scarce tribe of the Harpalinae. Bouchard et.al. (2011) and Baehr (2003a) both treat this group as a tribe, though historically it was often treated at the subfamily level as Zuphiinae. The Zuphiini can be distinguished from all other Chinese Harpalinae by a combination of the following features: head with two supraorbital seta; elytra truncated; body completely pubescent; antennal scape long; labrum not large and as broad as clypeus; mandibles without seta in the scrobe; pronotum with distinct lateral edges; and tarsal joint 4 not bilobed.

Two species of Zuphiini have been recorded from China, both belonging to the subtribe Zuphiina. Baehr (2003) lists *Zuphium olens* P. Rossi 1790, a well marked species, distributed from North Africa and southern Europe to Yunnan in China, Annam and Cochinchina (roughly South and Central Vietnam), where according to Park et.al (2006) it is the only species of the tribe. Dupuis (1912) re-described *Zuphium siamense* Chaudoir 1872, a species described and previously only known from Thailand, from two specimens collected by H. Sauter in Taiwan.

The genus *Planetes* has occasionally been placed in the Zuphiini, though more often, including by Baehr (2003b) and Bouchard et.al. (2011), it is placed in the Galeritini. There are three Chinese species: *P. muiri* Andrewes 1924, described from Macau; *P. puncticeps* Andrewes 1919, described from Chinese and Japanese specimens originally labelled *P. bimaculatus* W.S. MacLeay 1825, with a wide distribution in China including Guangdong, and *P. formosamus* Jedlička 1939 in Taiwan. The author is unfamiliar with the genus *Planetes* but it can be identified from all Zuphiini by having the stria of the elytra duplicate, thus the elytra has 19 ridges (Baehr 1984) and can further be distinguished from the tribes Patriziina and Zuphiina by having the elytral border entire and males having tarsomeres 1-3 asymmetrically widened, whereas in Patriziina and Zuphiina the elytral border is not entire and the male tarsomeres 1-3 are only slightly, and not asymmetrically, widened (Baehr 1984).

## MATERIAL

While using a Philips Powertone ML 160 watt bulb as a light lure for coleoptera on 13 September 2011, on the roof

of a three storey building in Wang Tong village on Lantau island, an unusual beetle was found. It was designated as # 2 of 13/9/11 Wang Tong, Lantau, H.K.(L). The specimen was a female and was identified as a Zuphiini using Andrewes (1935), though the specimen differed from all eastern palaearctic genera. The species was tentatively identified as *Agastus lineatus* Schmidt-Goebel 1846 by Dr. Baehr, based on photographs. Species identification was confirmed using Baehr (1987). This constitutes the first record of this species for China.

## DESCRIPTION

Entire body pubescent, mostly fulvous, each elytron with an ill-defined pale area from base to three quarters length of the elytra. Apical sixth of elytra and head darker with more of a reddish hue. Head large, squared sub-basally and sharply narrowed basally to a "neck" about half the maximum width of the head. Antennae, palps and legs paler, the latter two being closer to testaceous in colour. Antennae moniliform with the scape equal in length to antennomeres 2+3. Labial palps small, with the apical segment longer. Maxillary palps large with the apical segment huge, incrassate and truncate apically. Pronotum cordate, with a lateral tooth about an eighth from the base, heavily and densely punctate throughout, though less so on the disc; setae on the anterior angle and lateral tooth; broadly longitudinally sulcate medially from base to just behind the anterior border. Elytra, elongate and parallel sided with each elytron separately rounded, the first seven intervals costate. Length 5.1mm. A photograph of the specimen is given in Figure 1.

## NOTES ON THE BIOLOGY

Species of the genus *Agastus* are extremely rare and are distributed throughout the old world with the exception of Australia. *A. lineatus* is the commonest species of the genus, with a distribution from India to the Philippines and Indonesia, though it is still extremely rare and like most species of the genus only known from females (Baehr 1987 & Baehr pers. com.). Interestingly Baehr (1987) draws "... attention to the huge, glandular apical segments of their maxillary palpi and thought it possible, that these beetles live in ants and termites nests, with the consequence, that they are collected only sporadic when flying to light."

# KEY TO THE CHINESE SPECIES OF ZUPHIINI (PARTLY EXTRACTED FROM BAEHR 1984.)

1. Antennae short, moniliform, not reaching base of pronotum. First segment of antennae as long as second and third segments together. Head wide behind eyes, square, back of head straight, hardly narrowed. Eyes large. Last segment of maxillary palp very large, enlarged to tip. Elytra parallel, apex roundish cut off, somewhat drawn in to middle. Elytra each with six fine ridges .....  
Tribe **Patriziina**. (*Agastus lineatus* Schmidt-Goebel 1846.)

- Antennae longer, not moniliform, extending beyond base of elytra. Last segment of maxillary palp normal, only slightly enlarged to tip. Apex of elytra not rounded nor drawn in to middle. Elytra at most with one ridge at seventh interval....  
.....subtribe **Zuphiina**; 2

2. Elytra Brownish, without pale panels.....***Zuphium siamense* Chaudoir, 1872**

- Elytra dark with each elytron bearing a large pale maculation in basal half and another at the apex joining at the suture..... ***Zuphium olens* P.Rossi 1790**

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**Figure 1:** *Agastus lineatus* Schmidt-Goebel 1846 ♀ 3 September 2011 Wang Tong, Mui Wo, Lantau, Hong Kong. Note the terminal antennal segments are missing, though the apical segment of the right antenna is separately illustrated.

## Short note on a common agenielline wasp in Hong Kong, *Paragenia argentifrons* Smith, 1858 (Pompilidae: Pepsinae).

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### ABSTRACT

Observations of the nesting biology of *Paragenia argentifrons* were carried out in Hong Kong by using bamboo nest traps; in-situ records of active nests are also provided. The results are consistent with the only detailed observation, which was made by Williams (1919), except for the fact that the wasp was observed nesting in the open and used a different prey species, although in the same family that the one recorded by Williams.

As with other species in the tribe, *P. argentifrons*, displays some level of behavioural plasticity.

**Key words:** *Paragenia argentifrons*, Sparassidae, *Thelcticopis* sp., nest traps, nests in the open.

### INTRODUCTION

*Paragenia argentifrons* Smith, 1858 is a common spider wasp locally, and is probably the only species in the genus for which the behaviour is well documented. Indeed Williams (1919) provided the only detailed account of the habits of this wasp, and as he rightly formulates it “*The life of this rather widespread Oriental insect is a most interesting one, for, like its larger relative Macromeris it is fond of company...*”. As with some other representatives of agenielline (five in total) (Shimuzu et al. 2010), this species displays intricate nesting behaviours, which are believed to be communal with several females and generations cohabiting and performing nesting activities within the confines of one nesting site (Williams 1919; Evans 1970; Tsuneki 1976, Shimuzu et al. 2010), usually bamboo segments although nests constructed in the open are also observed.

I have not directly observed the detailed behaviour of this species; I essentially describe here the nest architecture, prey and life cycle from observations carried out on bamboo nest traps, complemented by additional observations *in-situ* of two nests made by John XQ Lee (JL), Hong Kong in 2006 and 2010.

### MATERIALS & METHOD

Observations on the biology of *P. argentifrons* were made on nest traps placed in and collected from the author's garden: Hong Kong; Pak Sha O; UTM: 50Q KK 237 850, alt. 70 m above sea level. They were placed at different accessible heights in branches of bushes and trees with varying orientations but all were in shaded or semi-shaded conditions.

The traps consisted of hollow bamboo canes that were cut so that one end was closed by a nodal septum with seven of them bundled together. The segments were of variable lengths and diameters. Physical measurements of each

trap are given in Table 1.

Traps were opened in the laboratory by splitting the bamboo segment using a pen knife. Quantitative and qualitative data pertaining to brood, parasites, prey, cell dimensions, etc. of four nests comprising totally 12 cells were obtained at tube opening. Those with live brood were re-assembled using masking tape and stored for rearing in Ziploc® bags.

The seasonal presence of adults was monitored in the study area with one resident Malaise trap and occasional hand net captures.

Identification of the wasp was undertaken by Prof. James Pitts, Department of Biology, Utah State University, USA. Voucher specimens are deposited at the same university.

Photography of nest content was undertaken with a Nikon D200 DSLR camera equipped with a Nikkor 60mm macro lens and Sunpak D12 ring flash. A stainless steel ruler was placed in the frame for measurements. Images were edited using Nikon Capture NX and Adobe Photoshop CS5.

### OBSERVATIONS AND DISCUSSION

#### Nest architecture

Nests collected by the author contained 3-6 (mean = 4, n = 3) mud cells assembled in a linear fashion inside the bamboo segment (Fig. 1). The cells were ovoid, measuring 20-25mm (mean = 22.2mm, n = 10) on the long axis and 13-15mm along the short axis. The walls were thicker at the base where they were attached to the trap sides, measuring 1.5-2mm while they were about 1mm at the apex.

I relate here observations made by JL showing that nests can be constructed in the open in Hong Kong. The single nest (PTC-001) at Pak Tam Chung, Hong Kong was affixed to the side of a plastic trash bin. On first observation (07 July 2012), the nest had 10 cells of which five had had their brood emerge and five were sealed. It had 12 cells when it was photographed (Figs. 2 & 3) on 22 July 2012, from which nine had emergence holes, one was about to be sealed and two were sealed.

Williams (1919) reported up to 24 cells in a nest, and it is probable that depending on the cavity chosen and the prevailing environmental conditions, the wasps may build that many cells over the life span of one nesting site.

The cell sides are built from the inside, the wasp flexing her abdomen in the cavity and plastering material with its tip. As a consequence the cell interior is smooth, while the exterior is much rougher. She leaves an orifice for inserting the prey which is roughly oval and approximately 10mm at its longest. This orifice is closed from the outside and assumes a lesser concavity, but a greater smoothness than the sides, because it is constructed at the end of the pro-



cess and from the outside as was described by Williams (1919).

Interestingly, the wasp also occasionally deposited mud posteriorly, close to the nodal septum in the form of a pseudo-diaphragm (Fig. 4); the purpose of which is unclear, but maybe used by the wasp as a store of readily available mud for construction of new cells. Representatives of the tribe are known to use mud from adjacent cells to built new cells (Williams 1919; Iwata 1976), probably storing excess mud on each cell for this purpose.

### Prey, brood and adults

The only prey record is by Williams (1919) who reported the wasp provisioning her cells with specimens of *Heteropoda gemella* Simon 1877 (Sparassidae). The wasps that nested in the traps in Hong Kong furnished their cells with another Sparassidae species, *Thelcticopis* sp. (Dickson Wong, Det. 2012) (Fig. 5). The prey were lightly paralysed and generally partially amputated, but the pedipalps were always intact. They were placed venter up in the cells, while the egg was oviposited on the left latero-dorsal side of the abdomen close to the cephalothoracic junction (Fig. 6).

I was unable to determine the length of the life cycle as all eggs and small larvae that I recorded (by extracting and replacing brood and prey) died before maturity, probably due to my mis-handling.

The cocoons were single layered and attached by their basal end to the cell wall and also supported by silk strands glued to various points of the cell interior. In colour they were light iron-oxide brown, slightly translucent.

The wasp was active from mid-March to at least November as recorded from capture by hand collecting with an aerial net, Malaise traps and also by JL (pers.comm). It is, therefore, more than likely that the wasp is multi-voltine in Hong Kong. Additionally, in two nest traps (PSO-195.A4 and PSO 195.A6) at least one individual was present and sheltering in the trap, they flew off at collection.

No parasites were observed, which is likely due to the protection provided by the sheltering female(s) as is reported for wasps that are continuously present during the developmental stages of the brood (Evans and West-Eberhard 1970; Cowan 1991).

### Communal nesting

I did not directly observe communal nesting, but JL's observation on another nest (FYU-001) in 2010, housed inside a bamboo at Fung Yuen Butterfly Reserve, Hong Kong showed that up to four individuals were present when observed late in the season (November 2010).

It is more than likely that there is an overlap of generations on one nesting site with each individual female behaving as a solitary individual. It remains to be proven that the nesting behaviour of this species involves active cooperation (Evans 1970).

This particular nest also witnessed a strange association: by November a brown tree frog (*Polypedates megacephalus* Hallowell, 1861) had selected the bamboo cavity as a hibernation site, while a wasp(s) was still inside (Fig. 7).

### Sex ratio

From the two reared traps emerged seven adults, five were males and three females or a male biased ratio of nearly 2:1, a bias that may be the consequence of the small sampling range. An additional nest yielded one male, but the other active brood that this nest contained died after my inspection.

### CONCLUSION

The nesting behaviour of *P. argentifrons* (cell construction, prey provisioning and oviposition) conform tightly to sequence 4b of Evans's (1970) evolutionary scale: Nest-prey-egg-[cell closed & new cell prepared-prey-egg]-closure.

The observations related here confirm Williams' own in general; however, prey record and nesting in the open are new observations for this species. The variability in the choice of nesting site described here, adds to observations by others showing that in Pompilidae, individuals may display a certain level of behavioural plasticity (Evans 1953; Wcislo *et al* 1988; Evans & Shimizu 1996; Harris 1999; Barthélemy 2010; Shimizu *et al* 2010) to accommodate for environmental conditions.

While this paper is the second monograph on this species, much data remains to be collected to fully understand the biology of this wasp such as details pertaining to the choice of construction site, the relations in communal nesting, voltinism and development time.

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I am very grateful to James Pitts, Department of Biology, Utah State University, USA who reviewed the final draft and identified the wasp. I am also indebted to Graham Reels, Hong Kong for reviewing the original manuscript and proposing essential modifications to enhance the clarity of the text and Dickson Wong, Hong Kong for his identification of the prey.

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**Fig. 7-** A brown tree frog sharing a nesting site with *P. argentifrons*. FYU-001, Fung Yuen Butterfly Reserve, 2010. Photo John XQ Lee.

TABLES & FIGURES

Trap ID	Orientation	Height (cm)	Date set	Date Collected	Max. Diam., mm	Max Length, mm	Cell Number	L. Cell 1, mm	L. Cell 2, mm	L. Cell 3, mm	L. Cell 4, mm	L. Cell 5, mm	L. Cell 6, mm
PSO-164.A6	SSE	160	24-Jul-11	19-May-12	16.5	165	6	22	21	20	20	20	21
PSO-195.A4	N	143	16-Jun-12	4-Aug-12	20	170	3	23	?	?			
PSO-195.A5	N	143	16-Jun-12	4-Aug-12	20	165	N/A						
PSO-195.A6	N	143	16-Jun-12	18-Aug-12	21	166	3	25	25	25			
Mean					19.38	166.50	4.00	23.33	23.00	22.50	20.00	20.00	21.00
Max					21.00	170.00	6.00	25.00	25.00	25.00	20.00	20.00	21.00
Mini					16.50	165.00	3.00	22.00	21.00	20.00	20.00	20.00	21.00

Table 1. Trap Data.



**Fig. 1.** A typical nest at opening, trap PSO-164.A6, 19 May 2012. Photo author.





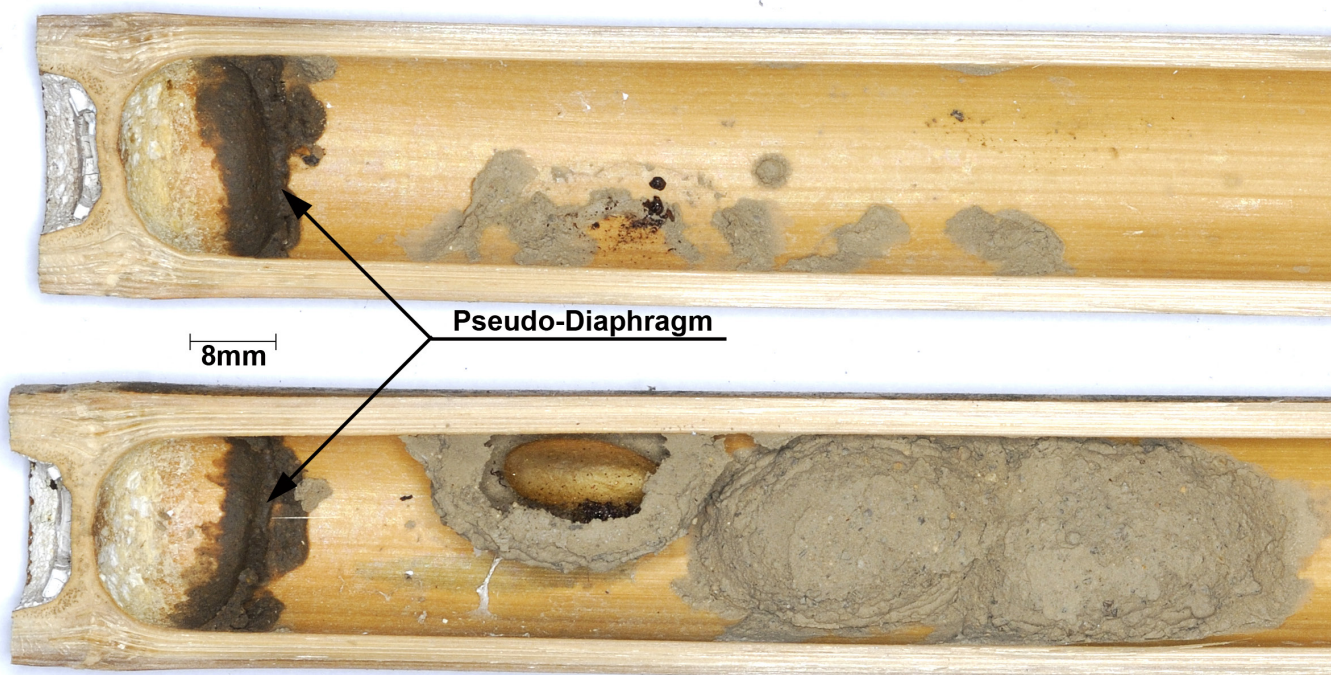
**Fig. 2 & 3.** *P. argentifrons* nesting in the open, nest PTC-001, 22 July 2006. Photos John XQ Lee



**Fig. 5-** Prey of *P. argentifrons*, *Thelcticopis* sp. Nest PSO-195.A6, 19 August 2012. Photo author.



**Fig. 6-** Oviposition site on prey. Nest PSO-195.A4, 12 August 2012. Photo author.



**Fig. 4** Nest PSO-195.A4 showing pseudo-diaphragm, closed cells and cocoon exposed by author. 12 August 2012. Photo author.



## Notes on the biology of *Vespa soror* (Hymenoptera: Vespidae) in Hong Kong

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### ABSTRACT

A general account of the biology of *Vespa soror* in Hong Kong is given, including its nesting habits, nest structure and an account of the raiding behaviour of this species on colonies of honeybees and other social wasps.

**Key words:** Hymenoptera, Vespidae, *Vespa*, *soror*, *mandarinia*, *ducalis*, hornet, wasp.

### INTRODUCTION

*Vespa soror* du Buysson, 1905 is one of the largest species in the genus *Vespa* (commonly known as hornets) in Hong Kong. It is closely related to *Vespa mandarinia* Smith, 1852, which is extremely rare in Hong Kong and apparently confined to the outlying islands (Lee 2010; pers. obs.). Apart from some cursory information on its biology, nesting habits and nest structure given by Lee (2009a, b), little is known about its biology in most parts of its range.

The distribution of *V. soror* includes northern Thailand, Vietnam, the southern regions of mainland China and Hong Kong. It is widely distributed within Hong Kong, although it is more common in rural and countryside environments. Individual wasps are commonly seen, but nests are rarely found. Individual wasps and nests are seldom found near seaside environments.

This paper aims to add on to what has been written about *V. soror* thus far, and to provide information on its general biology, nesting habits, colony cycle, and the way it invades and occupies nests of honeybees and other social wasps. All information in this paper is a result of observations made in the wild from 1996 to 2012, unless otherwise stated.

### OBSERVATIONS AND DISCUSSION

#### Identification

*Vespa soror* is often mistaken for *V. ducalis* Smith, 1852 in Hong Kong and mainland China. However, *V. soror* is distinctly more robust, with a wider head, enlarged gena and broader mandibles. In contrast, *V. ducalis* is more slender in build, with a smaller head, and gena not enlarged. The yellow, brown or orange bands on the first two gastral segments of *V. ducalis* are more contrasting in shade, and there is also sometimes a yellow band on the third gastral segment. However, differences in colour are not as reliable in distinguishing the two species as the morphological characteristics. Workers range from 25mm (the first workers in a nest) to 40mm in body length (large workers at the colony's peak). Males range from 30mm – 37mm, and queens range from 34mm – 48mm. All measurements were taken from specimens the author collected over the period 2000-2012. Photos showing how to separate *V. soror* and *V. ducalis* can be found in Barthélémey (2008) and Lee (2009a).

#### Colony cycle and general biology

*Vespa soror* colonies are annual and synchronized (Lee 2009a; pers. obs.), with each stage of the colony cycle taking place approximately at the same time each year. New queens appear from early March to mid-May (the author's earliest personal record was of a queen in late February) and begin feeding. Shortly after this, they begin searching for suitable nest sites. The first workers usually appear in June, although the author has recorded workers in May. Males appear around the end of November, while new queens appear in December. Colonies are usually abandoned after December or January of the following year. The peak period is August to the beginning of December. The actual number of worker at peak is unknown by lack of precise data, but may exceed 200-300, based on the size of the combs and nests that were directly observed.

Vespid wasps generally require two types of food. The larvae require food rich in protein, such as the flesh of other insects, which are captured and killed by the adults. However, adults also require food rich in carbohydrates, and thus both new queens and workers can be seen at many different plants during different times of the year.

The new queens generally feed on flowers of lychee (*Litchi chinensis*), which blooms in spring, when new queens of many social wasps first emerge in Hong Kong, as well as flowers of banana trees (*Musa sp.*) and sap from the trunks of *Citrus sp.* As observed over the years, workers often feed on the above-mentioned sources of nectar or sap, as well as fallen or over-ripe fruit, sweet food or drinks discarded by humans, and many other flowering plants, including flowering trees such as *Lingustrum sinense*. (Barthélémey, pers. comm).

This species is a ferocious predator. It will prey on any insect it can overpower. In late summer, workers of *V. soror* will often attack the nests of Polistine wasps or even other smaller hornets and honey bee colonies to provide food for their developing brood (personal observation; Barthélémey 2008, Lee 2009a, b). In autumn, *V. soror* will begin hunting even larger prey, such as the mantid *Hierodula sp.* On rare occasions, it will also hunt small vertebrates, such as geckos (Lee 2009a, b).

The mating habits of *V. soror* appear similar to that described for *V. mandarinia* (Matsuura and Sakagami 1973), where males wait outside the entrance of another nest for new queens to emerge. In 2006, the author observed males waiting at the entrance of a mature nest, and attempting to catch hold of larger individuals which appeared to be new queens emerging from the nest; however, they were unsuccessful. In 2011, a dead pair which had apparently been run over by a vehicle was discovered less than 5m from another mature nest, and appeared to have been in the process of copulation, the full process has yet to be observed.

### **Nesting habits and nest structure**

*Vespa soror* usually nests underground or in crevices (Barthélémy 2008, Lee 2009a; pers.obs.). It prefers to nest at low altitudes; nests are seldom seen above 400m (pers. obs.). An incomplete envelope consisting of only one layer covers the sides of the embryo nest. Mature nests also have a thin and incomplete envelope consisting of one to two layers, and the bottom combs are exposed. The envelope is mainly laminar, with horizontal markings. The basal and dorsal side of the combs assume a conical profile, with new cells built lower than the central cells. Although the envelope is brittle and fragile, the combs are much more solid and sturdy compared to those of other local hornets.

On rare occasions, nests may be built inside abandoned houses in rural areas. The author has never seen an actual nest inside a house; however, on two occasions a large number of *V. soror* workers were seen leaving and entering abandoned structures in rural villages. In Japan, the closely related *V. mandarinia* has also been noted to nest in houses, although this is also a very rare occurrence (Matsuura and Koike 2002). However, the author once observed an unusual situation – a queen of *V. soror* began construction of a nest on a steel wire inside a disused wooden bee hive. The nest eventually failed due to being attacked by ants.

On 29 April 2009, the author found an abandoned *V. soror* embryo nest in a house in a rural part of the New Territories. The diameter of the envelope was 13cm, while the cells averaged 10mm in diameter. The construction of the nest was identical to the embryo nest in the bee hive. The comb was fragile, while the envelope was sturdy – the complete opposite of mature nests. Also, the pedicel was very long, measuring 2cm. These observations show that *V. Soror* may indeed occasionally nest above ground or in the open, such as in abandoned houses.

Six nests dissected between 2007 and 2012 on periods ranging from September to January revealed that mature nests may have between four and seven combs. If the cavity in which the nest is built is unobstructed, the combs in early and mid-stage nests tend to be roughly circular, like most other hornets. However, combs in mature nests tend to become elongated. Each comb is connected to the one above it by many auxiliary pedicels. Mature nests have between 2500 and 3000 cells on average (sampling range as above). Most cells are used between two and three times. The cells on the outer edge of each comb, usually comprising up to one fifth of the comb, are often incomplete.

In two mature nests the author dug out after the end of the season, the first and second combs were covered in mould and malodorous, and were infested with parasitic insects. In fact, mould is present on the upper combs on almost all mature nests, even in occupied nests, which indicates that this species usually does not attend to or repair the upper combs.

In the first comb, the cells are usually smaller, measuring 9-10mm in diameter and 28mm deep. The pupal cell closure fabricated by the larva may extrude by as much as 5mm beyond the cell rim. From the second comb onwards, the cell diameter increases by 1mm on average, with varying cell depth (the author measured a maximum cell depth of

50mm). Queen cells on the bottom combs can measure up to 14mm in diameter.

From late July onwards, the workers enlarge the nesting cavity by excavating and disposing of the soil outside which accumulates at the entrance as a large pile. The nest may be 10cm to 60cm deep; with most nests the author observed being around 30cm underground. Mature nests may have one to three entrance tunnels.

If the nest location is just below the surface, some envelope may be seen from the entrance.

### **Colony defence and temperament**

The defensive behaviour of *Vespa soror* is variable and is somewhat synchronized with the colony stages (pers. obs.).

From spring to early summer, colonies are generally non-aggressive and will not attack unless the nest is disturbed. However, colonies start to exhibit territorial behaviour from mid-August. Several individuals take their place as guards at the entrance, and upon approach, the guards will focus their attention on the intruder, and may even fly out and show warning behaviour by making clicking sounds with their mandibles. If one doesn't leave by this time, there is a high chance of being stung.

In mid-stage nests, several guards remain close to the entrance for two hours after nightfall, and only retreat into the tunnel later. After the end of September, the guards remain outside the entrance till near midnight. Due to lack of observations later than this, it is not known how long into the early hours the guards remain at the entrance.

Towards the end of autumn (November to early December), the colony becomes extremely defensive, and the defended territory increases. During this time, workers often circle the area, and upon the slightest disturbance, a large number of workers swarm out and attack. Workers in a mature colony may give chase for over 30m upon disturbance. The extreme aggressive behaviour of the colony late in the season may be the result of it being at the reproductive stage, the workers defending the up-coming drones.

The sting of *V. soror* causes severe pain and swelling as experienced by the author on several occasions.

### **Attacking honeybee colonies**

Matsuura and Sakagami (1973) describe how *V. mandarinia* attacks honeybee colonies. Unlike other hornets which capture honeybees one at a time near the nest entrance, *V. mandarinia* is able to invade and completely annihilate entire colonies and seize all the brood in a process consisting of three stages, namely the hunting phase, slaughter phase and occupation phase.

The author observed this same process in *V. soror*. Although the entire process wasn't observed in one same colony from start to finish, all three phases were observed in several different honeybee colonies.

During the summer of 2005, the author witnessed *V. soror* attacking a honeybee colony in a small-scale apiary. The attack began in mid-July, with only one or two workers at each time loitering outside the hive and attempting to



capture honeybees leaving or returning to the nest. After capturing a bee, each hornet would proceed to land on a tree nearby, bite off its appendages and masticate the body before leaving. Upon returning to the same apiary after a few days, there were now several workers of *V. soror* at any one time, sometimes more than ten. They had already begun slaughtering the bees, and the ground around the hive was littered with corpses. The *V. soror* workers no longer took honeybees away one by one, but instead kept attempting to enter the hive. However, they didn't manage to enter due to the fact that the entrance was too small. In the end, all the *V. soror* workers were killed by the owner of the apiary, so no further observations were made. According to the owner, *V. soror* workers were occasionally seen attacking bees at the apiary, but the owner killed them before they caused any real damage.

In 2011, the author observed *V. soror* slaughtering and occupying three bee colonies. In late July, a colony located within the wall void of a wooden shelter serving as a security post in a country park in Tai Po was occupied by *V. soror*. There were many dead bees on the ground, and the *V. soror* workers continually attempted to kill bees returning to the nest. Other *V. soror* workers were also observed to rub their gasters against the wooden surfaces outside, possibly leaving pheromones to mark the site. During this period, four other *Vespa* species, namely *V. ducalis*, *V. tropica* (Linnaeus, 1758), *V. velutina* Lepeletier, 1836 and *V. bicolor* Fabricius, 1787 were seen to take advantage of the colony being weakened by *V. soror*, and entered the nest. The author also noted that individuals of *V. tropica* and *V. ducalis* reemerged and flew away 10 to 15 minutes after entering the occupied honeybee nest, with their abdomens visibly distended, possibly a result of ingesting honey or body fluids of the honeybee brood. However, individuals of the smaller *V. velutina* and *V. bicolor* didn't leave the nest after entering it. It is possible that they were killed by the *V. soror* workers occupying the nest as all the bees had been killed by this time.

Another colony was located in a crevice between rocks on a slope, and also fell victim to *V. soror* and was occupied in the same manner. During this period, workers of *V. soror* were seen travelling between the two colonies. This observation differed from what Matsuura and Sakagami (1973) reported, where *V. mandarinia* would not divert their attention from an attacked colony during the slaughter phase. Upon returning after a few days, the nest in the shelter had been completely slaughtered, and the *V. soror* workers began to show slight defensive behaviour towards the author. Individuals were seen taking pupae away from the colony.

The colony in the rock crevice had also been occupied, and the *V. soror* individuals in this nest were much more defensive, resulting in the author nearly being attacked upon approach. This is similar to what Matsuura and Sakagami (1973) described. The author remained at the scene until late at night for the purpose of observation, and noted that several workers remained and guarded the surrounding area.

The third colony was located approximately 100m from the shelter. The occupation phase seemed to be in its most active stage, and more than ten workers could be seen

outside the entrance at any one time, with others continually taking honeybee brood away from the nest.

At the beginning of August, all three occupied nests were abandoned. Towards the end of August, the author found a *V. soror* nest on a slope just 100m away from the third colony.

Besides attacking honeybee colonies, *V. soror* workers have also been known to attack and occupy colonies of smaller hornets and other social wasps such as *V. bicolor* (Lee 2009a) and *Parapolybia indica* (Saussure, 1854) (Barthélémy 2008).

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## 關於黃紋大胡蜂 (*Vespa soror*) 在香港的生態習性

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### 摘要

本文論述黃紋大胡蜂的生態習性，包括其築巢習慣，蜂巢構造及此品種集體入侵和佔據其他社會性蜂類巢穴之習慣。

關鍵字: 膜翅目、胡蜂科、胡蜂、黃紋大胡蜂、金環胡蜂、黑尾胡蜂

### 簡介

*Vespa soror* Du Buysson, 1905 (黃紋大胡蜂) 為本港一種最大型的胡蜂，與在香港極為罕見且局限分佈於離島區 (Lee 2010; 個人觀察) 的 *Vespa mandarinia* Smith, 1852 (金環胡蜂) 關係亦比較密切。但除了 Lee 2009a 及 2009b 之外，關於此品種的生活習性等資料甚少。

*Vespa soror* 分佈於泰國北部，越南，中國南部及香港。在本地分佈廣泛，但在郊外環境較為常見，而工蜂不難見，但蜂巢則比較罕見。近海環境亦比較難見到工蜂及蜂巢。

本文將談述本種於香港的行為習性，包括築巢行為、蜂群循環及入侵和佔據其他社會性蜂類的捕食習慣。本文中的資料之來源為筆者於1996年至2012年的個人觀察記錄。

### 觀察與討論

*Vespa soror* 在本港經常與 *Vespa ducalis* Smith, 1852 (黑尾胡蜂) 所混淆，但 *V. soror* 體型明顯較粗壯，頭部較發達，頰部較闊，顎較大。然而 *V. ducalis* 體型則較瘦長，頭部較小，頰部較窄，顎較小。另外 *V. ducalis* 腹部前半部的黃橙色斑紋對比明顯較強，腹部後半部時有多一條黃間。因此，此分辨方法未必準確，用頰部闊窄分辨則為最準確分辨兩種胡蜂的方法。

工蜂體長 2.5 mm (初期工蜂) 至 4.0 mm (後期工蜂)，雄蜂身長 3.0 mm 至 3.7 mm，蜂后體長 3.3 mm 至 4.8 mm。尺寸資料來源為筆者於2000年至2012採集的標本。Barthélémy (2008) 及 Lee (2009a) 文中含有有助於分辨兩種的圖片。

#### 蜂群循環期及一般習性

*Vespa soror* 蜂群循環為一年期 (Lee 2009a; 個人觀察)。蜂后由初春三月初 (筆者最早紀錄為二月尾) 至五月中出現進食，並開始尋找地方築巢。初期工蜂通常於六月初開始出現 (最早紀錄為五月尾)，雄蜂於11月尾開始出現，新蜂后於十二月出現，蜂群於十二月至翌年一月解散。蜂群最繁盛時期為八月至十二月初。高峰期蜂群數量尚未知，但從筆者觀察的蜂巢和巢脾之尺寸，估計可達到或超越兩至三百隻。

社會性胡蜂的幼蟲需要含豐富蛋白質的食物，例如其他昆蟲的肉。然而，成蟲則需要進食含高糖份的食物，因此新蜂后及工蜂會在每年的不同時段出現於不同的植物。蜂后於初春出現進食，最常到的蜜源為荔枝花 (Litchi

chinensis) (春季開花，正值各種新蜂后出現之時)，蕉科的花 (*Musa* sp.) 及芸香科柑橘屬 (*Citrus* sp.) 植物的樹汁。然而，工蜂除了吸食上述的植物蜜源外，也會吸食其他植物的花，包括山指甲 (Barthélémy, pers. comm.)，已跌落或過熟的水果，以及人類留下的食物或飲料。

本種是非常兇猛的獵食者，各類可被制服的昆蟲均可視為本種的獵殺對象。深夏時份，本種經常攻擊其他馬蜂甚至小型胡蜂或蜜蜂的蜂巢以獲取其幼蟲 (個人觀察; Barthélémy 2008; Lee 2009a, b)。至入秋時份，本種更開始捕捉更大型的獵物，尤其是斧螳屬 (*Hierodula* sp.) (Fig. 4)。本種亦會攻擊小型脊椎動物，如壁虎 (Lee 2009a, b)。

本種的交配行為似乎與其近親金環胡蜂 (Matsuura and Sakagami, 1973 所描述) 相同。筆者於2006年觀察過一個成熟蜂巢並察覺到有雄蜂於入口守候，並試圖捕捉看似是新蜂后的蜂，但未能成功；於2011年觀察另一個蜂巢時，於距離蜂巢不遠 (< 5m) 的位置又發現一對死屍，而且看似原本在交配中。雖然筆者尚未能觀看到整個過程，但相信與金環胡蜂的交配相似。

#### 築巢行為及蜂巢結構

*Vespa soror* 通常築巢於地底或岩洞等等空隙中 (Lee 2009a; 個人觀察)。此品種似乎較喜好築巢於海拔較低的地方，發現蜂巢的地點通常不會超過海拔400米 (個人觀察)。蜂巢初期為單一層不完整外殼覆蓋著巢脾的上半部。成熟蜂巢亦只有一至兩層脆弱並且不完整的外殼所覆蓋，外殼花紋主要為橫間紋，並露出最下層的巢脾。巢脾上面呈圓錐型，中間的蜂室位於較高，然而側面的蜂室則較中間的蜂室位置為低。巢脾並不似其他本地胡蜂般較脆弱，而是堅實得多。

極少數築巢於鄉郊的廢屋中，但筆者未能親眼看見一個有蜂的巢築於廢屋內，只有兩次目睹過有大量工蜂進出廢棄建築物內，但未能進入該建築物內查證。在日本，*V. mandarinia* 也有築巢於屋內的記錄，但這種情況亦非常罕見 (Matsuura and Koike 2002)。然而筆者亦見過一個特別的例子：一隻蜂后剛築巢於一個廢棄蜜蜂箱內的一條鐵絲上，但蜂巢最終因螞蟻攻擊而築巢失敗。

29/4/2009，筆者於新界一廢村內終能找到一個已遺棄的 *V. soror* 初期巢，外殼約為13cm闊，蜂室寬度10mm。蜂巢的質料與筆者多年前見的初期蜂巢相同，初期巢脾同樣的脆弱，而外殼則相反地較硬實，另外巢的支幹非常之長，長達20mm。此確實證明 *V. soror* 亦會築巢於建築物內等陰暗環境。

筆者於2007年至2012年剖析六個於九月份至翌年一月份收取的成熟蜂巢，六個蜂巢均有四至七個巢脾。若築巢位置並無任何異物阻礙築巢過程，蜂巢初期及中期的巢脾型狀與其他本地胡蜂一樣傾向圓型，但到後期的成熟巢脾則傾向長方形，並不似其他本地胡蜂的成熟巢脾傾向圓型。一個成熟的蜂巢可有2500~3000個蜂室，每個巢脾可有十數至廿數個連接位連接著上一層巢脾。大部份蜂室會重



用兩至三次，一個巢脾至少有五份一的邊沿蜂室未完成建成。其中兩個已解散的成熟蜂巢，第一及第二層巢脾同樣發霉得異常嚴重並且發臭，另有大量寄生蟲破壞最頂的兩層。然而即使是有蜂的蜂巢，最頂層的巢脾仍然有霉爛的情況出現，似乎此品種並不會打理較上層的巢脾。最頂層的巢脾，蜂室較細小，闊9-10mm，深度約為28mm（並不包括繭膜突出的高度），由第二層開始蜂室寬度平均遞增1mm，深度則不定（筆者紀錄最深的蜂室約為50mm），養育新蜂后的蜂室可達至14mm寬度。

筆者見過最大的巢脾為：最闊45cm；最窄33cm，並有約750個蜂室。

從七月下旬之後，蜂群為了擴大蜂巢而掘出泥土騰出空間，並且將掘出的泥土堆積於蜂巢入口前。地面與巢穴深度相距由10cm - 60cm不等，筆者見過大部份的蜂巢與地面深度差距約為30cm。成熟巢穴入口可由一個到三個不等。若巢穴築於較淺層，入口或能見小部份外殼。

### 蜂群的攻擊行為

*Vespa soror*的攻擊性於蜂群循環階段有直接關係(個人觀察)。本種的蜂巢由初春至初夏的攻擊性較低，除非對蜂巢作出騷擾，否則蜂群甚少作出攻擊。但蜂巢直到八月中開始，蜂群有明顯領域行為，入口開始有守衛，稍有接近，守衛便會注視甚至飛出作警告（以大顎發出“咯咯”的聲音），此時若不離開很大可能給螫。

據筆者經驗，中期蜂巢的守衛入夜後兩小時仍會於入口外作守衛，到稍夜才退回入口的隧道中；但直到九月尾開始，守衛增多並且停在入口外直到接近午夜，筆者未能整晚觀察，因此未知深夜時份的守衛是否仍在入口外守衛著。

當到深秋（約十一月初至十二月初），蜂群警覺性極高，領域範圍擴大，並時有工蜂飛出巡視，稍有屬擾，蜂群即群起飛出並作出猛烈攻擊。根據筆者以往經驗，騷擾一個成熟蜂巢，蜂群可追至約30米外遠。相信變得如此兇惡是關係於蜂巢的最後階段 - 繁殖新蜂后的階段。

筆者有數次被螫經驗。被本種螫可引起劇烈痛楚及紅腫。

### 攻擊蜜蜂巢

Matsuura and Sakagami (1973)論述金環胡蜂如何攻擊蜜蜂巢，筆者觀察上*V. soror*亦有一樣的行為，同樣分為三個階段，獵殺階段，屠殺階段及佔據階段。

雖然筆者未能有連貫性地觀察到*V. soror*整個過程，但仍分別見過該文章所述的三個階段。

筆者於2005年夏季，曾目擊本種攻擊一小型蜂場內的蜜蜂巢，大約七月中旬開始，最初亦只是一兩隻於蜂箱外徘徊，並捕捉外出或回巢的蜜蜂，成功捕捉後便飛往附近停留將蜜蜂咬成肉丸並飛離開，但到數天後回到蜂場觀察，情況截然不同，攻擊蜜蜂箱的工蜂數量增至數隻至十數隻，並對蜜蜂群進行屠殺，蜂箱底部堆滿蜜蜂屍骸，*V. soror*工蜂亦未見有帶走蜜蜂屍骸離開，並不斷試圖進入蜂箱內部，但入口太細小，工蜂無法進入，到最後蜂場主人見狀將所有工蜂打死，筆者無法再觀察。往後兩年據蜂場主人告知，仍不時有*V. soror*攻擊場內的蜜蜂巢，但都給蜂場主人所打死。

直到2011年，筆者有機會再觀察*V. soror*屠殺及佔據三個蜜蜂巢的情形，七月下旬於大埔一郊野公園內，一個

保安亭外有一蜜蜂巢（似是夾於木板與木板之間），被*V. soror*屠殺並且佔據，地上見到不少蜜蜂的死屍，涼亭外的*V. soror*亦不停屠殺試圖回巢的蜜蜂，亦見有*V. soror*停留時不斷用腹部掃擦木板，似乎在留下化學信息費洛蒙，其間亦有其他不同品種的胡蜂，包括*V. ducalis*, *Vespa tropica* (Linnaeus, 1758) (熱帶胡蜂), *Vespa velutina* Lepeletier, 1836 (黃腳胡蜂)及*Vespa bicolor* Fabricius 1787 (雙色胡蜂)，“趁火打劫”嘗試進入蜜蜂巢內。筆者亦發現*V. tropica*及*V. ducalis*進入蜜蜂巢後，十至十五分鐘後再出來，而腹部明顯膨脹（可能吸收蜂蜜或蜜蜂幼體的體液）。然而較小型的*V. bicolor*及*V. velutina*進入被*V. soror*佔據的蜜蜂巢之後，沒有再出來，有可能被*V. soror*殺死。

另一個蜜蜂巢則位於此涼亭前方約10米的斜坡石縫內，同樣受到*V. soror*的屠殺及佔據，並且於觀察其間看到有*V. soror*工蜂來往兩個蜜蜂巢之間。這點似乎與Matsuura and Sakagami (1973)所論述的金環胡蜂有點不同，*V. soror*於屠殺階段也會攻擊附近的蜜蜂巢。數天後再回去觀察，涼亭的蜜蜂巢內的蜜蜂似乎全被屠殺，然而*V. soror*工蜂亦開始對筆者的接近顯示出輕微的警告行為，其間有*V. soror*工蜂從涼亭中帶出蜜蜂的蛹飛出；石縫中的蜜蜂巢亦被佔據，但石縫中的*V. soror*警告行為比涼亭上的*V. soror*強烈，筆者嘗試接近，亦險被攻擊，與Matsuura and Sakagami (1973)所論述的金環胡蜂相同。筆者當天亦逗留到晚上繼續觀察，並發現被佔據的蜜蜂巢外有數隻*V. soror*工蜂作守衛。

第三個蜜蜂巢距離涼亭約100米，同樣被佔據，此巢的佔據階段似乎最強，最多可見十數隻*V. soror*工蜂堆於入口，並且不停取出蜜蜂幼體離開。

直到八月上旬，被佔據的三個蜜蜂巢再沒有*V. soror*工蜂出現。

八月中下旬，筆者才得知距離第三個蜜蜂巢外約100米的山坡上有一*V. soror*的巢穴。

除了攻擊蜜蜂巢之外，*V. soror*也會集體入侵而佔據其他小型胡蜂類或其他社會性蜂類之巢穴，包括*V. bicolor* (Lee, 2009a) 及*Parapolybia indica* (Saussure, 1854) (Barth é l é my, 2008)。

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### 參考文獻 - 請參考英文版

